

SECTION 05270
STAINLESS STEEL RAILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Stainless steel handrails (lighted and unlighted) and barrier railings:
 - a. Sections that are pre-fabricated from standard and custom components shop welded and finished.
 - b. Sections that are field assembled from standard and custom components
 - c. Miscellaneous metal or other materials fabrications as required for complete fabrication, assembly and installation of railings.
 - d. Welded wire mesh infill panels for barrier railings
 - 2. Glass infill panels at barrier railings (Add Alternate #1)

1.2 RELATED DOCUMENTS and SECTIONS

- A. Drawings and general provisions of the Contract, including General, Supplementary and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. General Structural Notes included in the drawings
- C. Related Sections include the following:
 - 1. Division 16 Electrical - connections for LED lighting
 - 2. Section 16900 - LED lighting to be installed in handrails

1.3 PERFORMANCE AND ASSEMBLY REQUIREMENTS

- A. Structural Performance of Handrails and Barrier Railings. Provide handrails and barrier railings capable of withstanding the structural loads without exceeding allowable design working stress of materials for handrails, barrier railings, anchors, and connections in accordance with the Design Criteria and Loads table in the Structural General Notes, and the following:
 - 1. Top Rail of Barrier Railings: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point and in any direction.
 - b. Uniform load of 50 lb. per linear foot applied horizontally and concurrently with uniform load of 50 lb. per linear foot applied vertically downward.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. applied in any direction.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 3. Infill area of Barrier Railings: Capable of withstanding a horizontal concentrated load of 50 lb. applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.

4. Load above need not be assumed to act concurrently with loads on top rails in determining stress on barriers.
- B. Field Assembly Requirements: Due to the unique character of the site, access for delivery and handling of materials is limited in some areas. Provide handrails and barrier railings, and anchors, connectors, accessories and other parts and materials necessary for complete installation, that can be assembled and installed from components of sizes and shapes that allow transport to these areas of limited access.
- C. Control of Corrosion:
 1. Passivation of all stainless steel parts and components in accordance with ASTM A 380.
 2. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Prior Approvals for substitution requests conforming to requirements of Sections 01300 and 01600.
- B. Product Data: For manufacturers product lines of handrails and barrier railings assembled from standard and custom components.
 1. Include Product Data for fasteners, accessories, grout, anchoring cement, and metal finishing.
 2. Include Product Data for Glazing
- C. Shop Drawings: Show fabrication and installation of handrails and barrier railings.
 1. Include plans, elevations, sections, details, and attachments to other work. Details shall include post locations and type of connection, joint locations, locations of conduit stubs for electrical connections, panel clips, transitions and terminations, and location and method of attaching brackets to barrier railing post for installing handrail. Identify sections to be fabricated prior to delivery to site and sections to be assembled on site for installation
 2. Include elevations and details for welded wire mesh panels. Show locations of panel clips.
 3. (Only if Additive Alt #1 accepted) Include elevations and details for glazing panels. Show locations of panel clips and method of attaching panels.
- D. Photos: show Field Mock-ups
- E. Samples:
 1. Short section of handrail and post adapter showing required finish.
 2. Minimum 12" x 12" piece of welded wire mesh
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Manufacturer's Certificates: Certify products meet or exceed specified requirements
- H. Installation Instructions: Submit manufacturer's installation instructions.
- I. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions.
- J. Record Documents: Provide professionally drafted record drawings accurately indicating and dimensioning railing configurations, post locations, type of post connection, bracket locations and conduit stub locations.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Source Limitations:
 - 1. Obtain handrail and barrier railing through one source from a single manufacturer
 - 2. Obtain all glazing through one source from a single manufacturer
- C. Manufacturer's on-site representation:
 - 1. A qualified representative from the manufacturer familiar with fabrication and installation of the railing systems shall be on-site during the entire time Field Measurement and Field Mock-up activities are taking place, and may be engaged to provide Field Measurements and Mock-ups.
 - 2. A qualified representative from the manufacturer familiar with fabrication and installation of the railing systems shall be on-site at the commencement of installation to instruct and train contractor's personnel in methods and techniques required for installation, if required by manufacturer.
- D. Passivation shall be performed by a qualified technician familiar with the methods and requirements, and regularly engaged in performing the process, with minimum 5 years experience.
- E. Installer qualifications: Manufacturer's trained installer or an installer acceptable to the manufacturer.

1.6 WARRANTY

- A. In addition to any written or implied product warranty by the manufacturer, the Contractor warrants and guarantees all materials and workmanship for the railing systems against rusting or corrosion for the one year warranty period.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials properly protected against damage to finished surfaces during transit.
- B. Inspect materials upon delivery for damage. Damaged parts should be removed and replaced.
- C. Store all materials in a dry, well-ventilated, weather tight place, in accordance with manufacturer's instructions
- D. Protect materials and finish from damage and contamination during handling and installation.

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation meeting near end of time Field Measurement activities are occurring. Provide minimum one week notice.
- B. Attendees: Contractor, Cave Specialist, Architect, Owner, Manufacturer's representative, Installer
- C. Review the following:
 - 1. Specific method of each type of post installation
 - 2. Proposed location of each post and type (grouted in or base plate) of installation proposed.
 - 3. Installation, adjusting, cleaning and protection of railing systems

4. Verify qualifications of Installer and/or manufacturer's representation
5. Coordination with other work
6. Protection of Cave Resources

1.9 PROJECT CONDITIONS

- A. Field Measurement: Verify handrail and barrier railing dimensions, each post location and termination detail by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
- B. Field Mock-up: In situations where field measurements may not adequately establish complex configurations required, provide models mocked-up in the field from other materials. Use models for shop fabrication processes.
- C. Field Measurements and Field Mock-ups shall take into account unique conditions and limited access of the work site.
- D. Note that manufacturer's representative shall be on site during all Field Measurement and Mock-up activities.

1.10 COORDINATION

- A. Coordinate with Cave Specialist for procedures to protect Cave Resources during the entire project.
- B. Coordinate installation of anchorage for handrails and barrier railings. Furnish Setting Drawings, templates, and directions for installing anchorages, including sleeves, tenons, concrete inserts, anchor bolts, and items requiring post-installed anchors, that are to be embedded in or anchored to concrete or native stone. Deliver such items to project site in time for installation.
- C. Coordinate installation of wiring and lighting, including diffuse lens cover.
- D. Coordinate installation of glass or welded wire mesh infill panels at barrier railings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with all project requirements, manufacturers offering products that may be incorporated into the Work include the following:
 1. Stainless Steel Handrails and Barrier Railings:
 - a. Organic Lighting Systems
205 W. Blueridge Avenue
Orange, CA 92865
(626) 969-6140
sales@organiclighting.com
 - b. C.W. Cole and Company, Inc.
2560 Rosemead Blvd
South El Monte, CA 91733
(626) 443-2473
info@colelighting.com
 - c. Other manufacturers of equivalent systems will be considered for substitution with Prior Approval

2.2 METALS

- A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.
- B. Stainless Steel: Type 316L, satin finish. See Structural General Notes for additional requirements.
 - 1. Pipe and Tubing: ASTM A269
 - a. Barrier rails and posts and posts for handrails: 1.90" OD round pipe
 - b. Lighted handrails: Specially formed 1.66" OD channel tube section with rectangular recessed cavity to accept lighting strips and lenses, post adapters, brackets, and other accessories as required for complete installation.
 - c. Unlighted handrails, transitions and terminations: 1.66" OD round pipe
 - 2. Brackets, Post Adapters, Sleeves, Flanges, Panel Clips and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
 - a. Provide brackets and post adapters with interlocking pieces that conceal anchorage. Locate screws out of sight.
 - b. Panel Clips: Provide manufacturer's standard or custom rectangular panel clips welded to barrier railing posts. Panel clips shall fasten glass or welded wire mesh panels mechanically. Provide rubber inserts.
 - 3. Plate: ASTM A240
 - 4. Welded Wire Mesh: 0.250" diameter wire 4" x 4" OC, plain weave, plain crimp
 - 5. Bar: ASTM A276

2.3 GLASS PRODUCTS AND GLAZING MATERIALS (See Add Alt #1)

- A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent glass, flat). Quality q3 (glazing select). Provide products complying with requirements indicated below for class, thickness, and manufacturing process that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR, Part 1201 for Category II materials.
 - 1. Clear glass: Class I (clear).
 - 2. Thickness: 1/2" unless otherwise noted.
 - 3. Manufacturing Process: Manufacture fully tempered glass as follows:
 - a. By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturers option, except provide horizontal process tongless and free of tong marks.
 - b. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council or another certification agency, acceptable to authorities having jurisdiction.
 - 4. Glazing Cement and Accessories: Provide glazing cement and related accessories recommended, or supplied by railing manufacturer for bonding glass to metal panel clips

2.4 FASTENERS

- A. Fasteners for anchoring railings to other construction: Select stainless steel fasteners to match railing components described above and as required to produce connections suitable for anchoring handrails and barrier railings to other types of construction indicated and capable of withstanding design loads.
- B. Fasteners for interconnecting railing components: Use fasteners fabricated from same basic metal as fastened metal.

1. Provide flathead countersunk, concealed fasteners for interconnecting railing components and for attaching them to other Work, unless exposed fasteners are unavoidable or are standard fastening method for handrail and railing indicated. Provide fasteners for use with star bit or allen wrench tools.
- C. Post-installed Anchors: See Structural General Notes
- 2.5 ADHESIVES
 - A. Adhesive for interconnecting railing components: Use A 63.80 Anaerobic Adhesive as manufactured by Euro-Lok GmbH.
- 2.6 THREADLOCKER
 - A. Anaerobic Sealant used for locking and sealing threaded fasteners. Use Loctite Threadlocker Blue 242.
- 2.7 PROTECTIVE EPOXY COATING
 - A. Water-based Tile Clad Epoxy Coating and Pro-Cryl Universal Primer, as manufactured by Sherwin-Williams or approved equivalent substitution.
- 2.8 GROUT AND ANCHORING CEMENT
 - A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.
- 2.9 RAILING FABRICATION
 - A. Assemble handrails and barrier railings in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 1. Assemble lighted handrails such that lighting points directly downward
 - B. For areas where access is limited provide parts and components to be assembled on site.
 1. Accurately cut railing sections, transition pieces and posts in shop to be assembled in the field based on field measurements and field mock-ups to minimize field cutting.
 2. Fabricate components to be assembled in the field such that connections are made with sleeves or other methods utilizing adhesive or mechanical fasteners.
 - C. Clearly mark units, components and parts for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
 - D. Form transitions for changes in direction of railing members as indicated in drawings meeting criteria as follows:
 1. At Barrier Railings: smooth 3" radius
 2. At Handrails:
 - a. For angles greater than or equal to 90 degrees: 3" radius or miter and weld
 - b. For angles less than 90 degrees: provide unlighted 1.66" OD pipe section with smooth 3" radius. Each leg maximum 3" long (past tangent point). Connect to lighted sections on each side with manufacturer's standard sleeve connector.
 3. At Handrail terminations (not including extended stub ends):
 - a. For return to walking surface provide integral 1.66" OD pipe post and railing leg bent to angle required with smooth 3" radius, 3" long (past tangent point). Connect to lighted section with manufacturer's standard sleeve connector.

- b. For loop returns, stop lighted railing short of last post. Provide 1.66" OD pipe post and rail in configuration indicated. Connect to lighted section with manufacturer's standard sleeve connector.
- 4. At extended stub end terminations of handrail: Extend lighted railing over last post as indicated.
- E. Welded Connections: Fabricate barrier railings with welded connections between all posts and rails. Due to limited access barrier railings may need to be fabricated in sections to be reassembled in the field. Provide mechanical connections between reassembled sections.
- F. Mechanical Connections: Fabricate handrails by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints that maintain structural integrity and appearance of overall assembly.
- G. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard post adapters, brackets, flanges, miscellaneous fittings, and anchors to connect handrail and barrier railing members to other construction.
- H. Fabricate standard and custom baseplates as indicated using manufacturer's standard or custom tenon inserts for posts.
- I. Provide inserts, baseplates and other anchorage devices to connect handrails and railing to concrete or native stone. Fabricate anchorage devices capable of withstanding loads imposed by handrails and barrier railings. Coordinate anchorage devices with supporting structure, in accordance with Structural General Notes
- J. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- K. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items. Close exposed ends of railing members with prefabricated end fittings.
- L. All welded connections shall be ground smooth and finished to match railings.
- M. Use only carbide or other non-metallic tooling that have not been used on other metals.

2.10 WELDED WIRE MESH PANEL FABRICATION

- A. Assemble welded wire mesh panels in shop, with all welded connections
 - 1. Ease edges of bar stock for frames
 - 2. Grind corners of frame to smooth 1/2" radius
 - 3. Grind all welded joints smooth and finish to match railings
 - 4. Use only carbide or other non-metallic tooling that have not been used on other metals.

2.11 GLAZING PANEL FABRICATION (Only if Add Alt #1 accepted)

- A. Glass Panels: Cut tempered glass to final size and shape, and drill holes for panel clips (if required) before heat treatment; provide flat ground edges; provide for proper edge clearance and bit on glass. Provide thickness indicated, but not less than that required to support structural loads.
- B. Straight Panels: provide tempered glass panels for straight sections.

2.12 STAINLESS STEEL FINISHES

- A. Finish: ASTM A480, No. 6, dull satin finish

- B. Appearance of finished work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 PASSIVATION

- A. Perform passivation process in accordance with ASTM A380 on all metal fabrications, parts and fasteners after fabrication (including drilling, grinding or other surface treatment) has been completed and materials have been thoroughly cleaned.
- B. After passivation, protect all materials from contamination or damage.

PART 3 - EXECUTION

3.1 DEMOLITION AND REPAIR:

- A. Demolish and remove all existing railings scheduled for replacement. Completely remove existing posts embedded in concrete and native stone. Where new posts are scheduled to replace existing, core hole to proper diameter and depth. Where existing posts are to be removed and not replaced, fill and patch as scheduled and directed by Cave Specialist.
- B. Patch and repair concrete as indicated.

3.2 EXAMINATION

- A. Examine existing conditions and substrates to verify that locations indicated for installing posts are suitable. Note that some adjustment to locations may be required to suit existing conditions, maximum spacing of posts, required edge distances and configurations of railings. Locate and mark locations, if not already done. Verify all post locations with Architect and Cave Specialist.

3.3 FIELD MEASUREMENTS AND FIELD MOCK-UPS

- A. Schedule manufacturer's representative and Field Measurement and Mock-up activities after demolition and examination have been completed. Make adjustments to post locations as needed and approved. Verify railing configurations, including heights, with Architect and Owner.

3.4 INSTALLATION, GENERAL

- A. Install railing system in accordance with manufacturer's instructions.
- B. Core new holes in concrete and native stone for embedding posts as required. At embedded posts provide protective epoxy coating to concealed portion of posts and set posts with non-shrink, non-metallic grout per manufacturer's instructions.
- C. If rubble is encountered where posts are scheduled to be embedded in cored holes, install posts in concrete 'pier' as indicated.
- D. At posts to be set on base plates, provide protective epoxy coating to concealed side of base plate and anchor to concrete or native stone as indicated.
- E. Fit exposed connections together to form tight, hairline joints, mechanically or adhesively fasten per manufacturer's instructions.
- F. Cutting, Fitting, and Placement: Perform Cutting, drilling, and fitting required for installing handrails and barrier railings outside the cave. Cutting or drilling inside the cave shall only be allowed with the express approval, in locations established and

under the supervision of the Cave Specialist. Set handrails and railing accurately in location, alignment, and elevation.

1. Do not cut or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed ¼ inch in 12 feet (5 mm in 3 m).
- G. No field or shop welding of railing components is allowed after fabrication and passivation processes have been completed. No welding is allowed inside the cave.
- H. Adjust handrails and barrier railings before anchoring to ensure alignment at abutting joints. Space posts at interval indicated, but not greater than that allowed by structural loads.
- I. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railing and for properly transferring loads to in-place construction.
- J. Coordinate with electrical for locations of post conduit stubs for lighting feeds.

3.5 RAILINGS CONNECTIONS

- A. Nonwelded Connections: Use mechanical joints, mechanically or adhesively fastened for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.

3.6 INSTALLING GLASS OR WELDED WIRE MESH PANELS

- A. Barrier railing posts shall have panel clips factory installed. Install assembly to comply with railing manufacturer's written instructions with rubber inserts.

3.7 THREADED FASTENERS

- A. Apply threadlocker to all threaded fasteners per manufacturer's instructions.

3.8 LED LIGHTING

- A. Install LED lighting components in accordance with manufacturer's instructions. Coordinate installation of wiring and lighting during assembly of handrails.

3.9 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Replace damaged components that cannot be repaired to Architect's acceptance.

3.10 FINAL CLEANING

- A. After protective coverings have been removed, clean all surfaces with damp (water only) cloth. Do not use detergents or other cleaning agents unless specifically approved by Cave Specialist.

END OF SECTION 05720

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 — GENERAL INFORMATION

1.1 PROJECT LOCATION

The project is located at the Lewis and Clark Caverns as indicated on the project site plan.

1.2 WHAT THE CONTRACTOR PROVIDES

The contractor provides all labor and materials necessary to accomplish the project as described in the specifications and on the drawings.

1.3 GENERAL SCOPE OF THE WORK

The contractor furnishes and installs lighting and electrical systems within the cave.

1.4 GENERAL REQUIREMENTS

1.4.1 GROUNDING

A ground wire shall be installed in all new circuits.

1.4.2 NEUTRAL SIZE

All circuits shall have a full sized insulated neutral. In no case shall a neutral conductor be used in common with any other circuit.

1.4.3 CONDUCTOR TYPE

The conductor type shall be a mixture of conductors in conduit within cabinets, GGC cord for the main distribution feeder, SOOW cord for the branch circuits, and leaky feeder cable for the communications system .

1.4.4 RECEPTACLES

All receptacles shall be NEMA 5-20R, Specification Grade unless otherwise indicated.

1.4.5 BOXES

All outlet, switching, and junction boxes shall be composite non corroding material regardless of wiring method.

PART 2 — SCOPE OF WORK

2.1 LIGHTING

The contractor furnishes and installs cavern lighting and lighting controls.

2.2 INSIDE POWER

The contractor furnishes and installs inside cavern power including main distribution feeder and branch circuits.

PART 3 - GENERAL REQUIREMENTS

3.1 SUMMARY

- A. This section specifies the basic requirements for electrical installations and includes requirements common to more than one section of division 16.

3.2 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.3 ELECTRICAL INSTALLATIONS

- A. Coordinate electrical equipment and materials installation with other electrical and lighting components.
- B. Verify all dimensions by field measurements.
- C. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring special positioning and delivery within the cavern.
- D. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations or damage to the cavern.
- E. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide connection for each service.

3.4 NAMEPLATE DATA

- A. Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
- B. Locate nameplates in an accessible location.

3.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage and handling.

- B. Store equipment and materials at the site as indicated on the drawings and the special conditions regarding the cave. Some equipment can be stored within the cave as indicated on the drawings.
- C. Protect stored equipment and materials from damage and protect the cavern completely from the transportation and storage of equipment..
- D. Coordinate deliveries of electrical materials and equipment to minimize cavern and construction site congestion. Note that equipment must be hauled within the cave without damaging any of the cavern formations.
- E. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations and maximum protection of the cavern formations and environment.

3.6 RECORD DOCUMENTS

- A. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; change orders; concealed control system devices.
- B. Mark specifications to indicate approved substitutions; change orders; actual equipment and materials used.

3.7 OPERATION, MAINTENANCE AND WARRANTY INFORMATION

- A. Include the following information in a 3 ring binder of suitable size and organized for convenient reference:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.
 - 5. The manufacturer's installation instruction books or sheets, and parts and/or packing lists.
 - 6. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

3.8 ENVIRONMENTAL PROTECTION

- A. The contractor shall not release any hazardous or any other materials including dust and water to the environment outside and inside the cavern during the course of this work.

- B. The contractor shall, in general, take all detailed precautions and measures during the course of this work to protect and safeguard the natural cavern environment. This shall be interpreted as a primary, rather than subordinate, requirement of the project.
- C. If there is a question regarding a work procedure that may release any material within the cavern environment, the Contractor must solicit review and approval from the Engineer and the Owner before proceeding.
- D. The Contractor shall submit a plan for spill containment and clean up for cavern protection in the event of a spill accident.

3.9 CLEANING

- A. Clean interior of light fixtures and the interior and exterior of lenses prior to final acceptance. Light fixtures that are sealed do not need for the interior to be cleaned.
- B. Clean up all waste or trash from the electrical work by collecting all trash and waste before it enters the cave environment. This is a detailed requirement which includes every non-cavern material such as wire strands, insulation, cable fiber filling, etc. This is far more detailed and comprehensive than a typical building construction project.

3.10 SUBMITTALS

- A. General contractor is responsible to coordinate project requirements involving more than one trade, is responsible to coordinate between trades and equipment suppliers, is responsible for performance of subcontractors to verify that equipment delivered to the project site for installation is in compliance with project plans and specifications, and must verify that such equipment will properly interface with equipment specified by other trades for installation and use on the project.
- B. For the purpose of meeting those responsibilities, General contractor:
 - 1. shall review all submittals from sub contractors;
 - 2. shall verify compliance of those submittals with project plans and specifications; and
 - 3. shall verify coordination of equipment identified in those submittals with equipment and/or work of other trades before forwarding submittals to project engineer for review.

Evidence of the General contractor's review and verification of the above requirements will be provided with submittals forwarded for review

End of Section

SECTION 16028

CODES AND STANDARDS

PART 1 -GENERAL

1.1 CODES AND STANDARDS

- A. Comply with these specifications, project drawings, and all applicable local, State, and National laws, codes, standards, and regulations. In the event of differing requirements, the most stringent applies. Applicable portions of the following shall apply:
 - 1. Cavern and all facilities or systems with electrical installations within the scope of the National Electrical Code (NEC) published by the National Fire Protection Association (NFPA 70).
 - 2. Rules regarding what can be done and what cannot be done within the cavern.

1.2 INSPECTIONS AND FEES

- A. Inspection and approval by the State or local Electrical Inspector will be required prior to acceptance by the Owner.
- B. The contractor is responsible for obtaining and paying for all necessary State or local permits and inspections.

1.3 SPECIAL REQUIREMENTS

The following are special requirements which may be more restrictive than the code:

- 1. Hot wires, neutral and ground wires are the same size unless otherwise indicated.
- 2. A ground wire must be pulled in all raceways regardless of raceway construction. Raceways shall not be used as the only ground conductor.
- 3. All connections must be torqued to specifications using a torque wrench.
- 4. Series rated breakers will not be allowed unless specifically authorized.
- 5. All neutral conductors must be insulated.
- 6. The neutral connection lugs of a duplex outlet shall not be used for connecting the in and out neutral conductors. Generally a pigtail will be required.
- 7. A ground wire must be installed for each circuit. A common ground wire for several circuits, even if located in the same conduit, is not allowed.
- 8. All connections to devices such as receptacles and switches shall be made using the device lug screw. Push-in connections shall not be used.

End of Section

SECTION 16030

TESTS AND DEMONSTRATION OF THE COMPLETE ELECTRICAL SYSTEM

PART 3 - EXECUTION

3.1 TESTING

- A. Carry out all normal testing and operational checks to assure a complete, safe, and reliable system, including, but not limited to:
 - 1. "Megger" tests for insulation of all feeder conductors, branch circuit conductors larger than #10 AWG, and service entrance conductors, installed in this contract. Test to assure no unsatisfactory leakage phase to phase, phases to neutral, and phases to earth/metallic ground. Maintain written record of test results at project site. Submit test results to the Owner as requested.
 - 2. Circuit continuity as needed for phase identification.
 - 3. Amperage tests to assure proper balancing of loads to the maximum extent possible among phases under operating conditions.
- B. Circuit all branch circuits as shown, connect to phase and circuit number indicated. Circuit changes shall have prior approval of the Owner.

3.2 CORRECTIONS

- A. Correct any discrepancies found as a result of the above tests including replacement of conductors, splices, reconnecting loads, changing phases, installing additional ground rods, etc.

End of Section

SECTION 16120

WIRES AND CABLES

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Electrical Requirements - Section 16010
- B. Codes and Standards - Section 16028

1.2 DESCRIPTION OF WORK

- A. Extent of electrical wire and cable work is indicated by drawings and schedules.
- B. Types of electrical wire, cable, and connectors specified in this section include the following:
 - Copper conductors.
 - Specialized cord
 - Tap type connectors.
 - Split-bolt connectors.
 - Wirenut connectors.
- C. Applications of electrical wire, cable, and connectors required for project are as follows:
 - For power distribution circuits.
 - For lighting branch circuits.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.
- B. Codes and Standards:
 - 1. NEC Compliance:
 - a. Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.
 - 2. UL Compliance:

- a. Provide wiring/cabling and connector products which are UL-listed and labeled.
3. ASTM Compliance:
 - a. Comply with applicable requirements of ASTM B1, 2, 3, 8 and D-753. Provide copper conductors with conductivity of not less than 90 percent at 20° C (68° F).

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing or damaging the cave environment. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.1 WIRES, CABLES, AND CONNECTORS

- A. General
 1. Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated.
 2. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98 percent at 20°C (68°F).
 3. Cord types are indicated in the catalog sheet, Section 16900.
- B. Cabinet or enclosure Wires:
 1. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated.
 2. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards.
 3. Select from the following UL types, those wires with construction features which fulfill project requirements:

Type THWN: For dry and wet locations; maximum operating temperature 75° C (167° F). Insulation, flame-retardant, moisture- and heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.

C. CABLES:

1. Provide UL-type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated.
2. Where not indicated, provide proper selection as determined by installer to comply with installation requirements, NEC and NEMA standards.
3. Specific cable requirements are indicated in Section 16900:

2.2 CONNECTORS

A. General:

1. Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated.
2. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards.
3. Select from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:

Types: 1. Pressure.
 2. Crimp.

Class:Insulated.

Kind:
 1. Copper (for Cu to Cu connection).

Style: 1. Combined "T" and straight connection.
 2. "T" connection.
 3. Split-bolt parallel connection.
 4. Tap connection.
 5. Pigtail connection.
 6. Wirenut connection.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General:

1. Install electrical cables, wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation" and in accordance with recognized industry practices and special cavern standards as indicated in the special conditions.

- B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work and to protect the cavern environment.

- C. Install UL Type THHW or XHHW wiring in schedule 40 PVC conduit, for branch circuits installed with in the service entrance and the lighting distribution cabinets.
- D. Use GGC #2/3 with ground for main power distribution feeders as indicated in 16900.
- E. Use 10/3 and 12/3 SOOW cords for lighting branch circuits as indicated in 16900..
- F. Keep conductor splices to minimum. Splices are acceptable to provide manageable lengths of cables for installation within the caverns and to prevent cavern damage.
- G. Install splices and tapes which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.
 - 1. Use splice and tap connectors which are compatible with conductor material.
- H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values.
 - 1. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

3.2 FIELD QUALITY CONTROL

- A. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.
- B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.
- C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.
 - 1. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

End of Section

SECTION 16135

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Wires and Cables - Section 16120
- B. Electrical Connections for Equipment - Section 16142
- C. Wiring Devices - Sections 16143

1.2 DESCRIPTION OF WORK

- A. Extent of electrical box and associated fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings specified in this section include the following:
 - Outlet boxes.
 - Junction boxes.
 - Pull boxes.
 - Bushings.
 - Locknuts.
 - Knockout closures.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.
 - 2. NEC Compliance:
 - a. Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
 - 3. UL Compliance:
 - a. Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings.
 - b. Provide electrical boxes and fittings which are UL-Listed and labeled.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Provide composite wiring boxes, of shapes, cubic inch capacities, and sizes including box depths as indicated, suitable for installation in a high humidity cavern location.

2.2 DEVICE BOXES

- A. Provide composite, nongangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation in high humidity cavern location.

2.3 RAINTIGHT OUTLET BOXES INSTALLED OUTSIDE THE CAVERN

- A. Provide corrosion-resistant, cast-metal, raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit. The face plate shall be spring hinged capable of protecting the receptacle from weather even when a plug is inserted into the receptacle. Standard spring hinge- covers are not acceptable..

2.4 JUNCTION AND PULL BOXES

- A. Provide composite junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit the humidity cavern environment and equipped with stainless steel nuts, bolts, screws, and washers.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES)

- A. Composite, Plastic, or FRP Construction that is suitable in strength for the function and non rusting/non corroding in a damp cavern environment.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General:
 - 1. Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements and in the locations within the cavern approved by the Engineer and the Owner.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work and with the Owner.

- C. Provide weathertight, composite outlets for interior locations exposed to cave high humidity environment.
- D. Extra holes or hole plugs are not allowed unless they can be demonstrated to be humidity proof.
- E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring and can be hidden from the cavern visitors.

End of Section

SECTION 16142

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Electrical Requirements - Section 16010
- B. Codes and Standards - Section 16028
- C. Test and Demonstration of Complete Electrical System - Section 16030
- D. Raceways - Section 16110
- E. Wires and Cables - Section 16120
- F. Electrical Boxes and Fittings - Section 16135

1.2 DESCRIPTION OF WORK

- A. Extent of electrical connections for equipment is indicated by drawings and schedules.
- B. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.
- B. NEC Compliance:
 - 1. Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.
- C. ANSI Compliance:
 - 1. Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

D. UL Compliance:

1. Comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated.
2. Provide electrical connection products and materials which are UL-listed and -labeled.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:

1. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and terminations of types indicated.

2.2 PVC CONDUIT, TUBING AND FITTINGS

A. General:

1. Provide PVC conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service.
2. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways.
3. Conduit shall be Schedule 40 PVC unless otherwise indicated

2.3 WIRES, CABLES, AND CONNECTORS

A. Wires/Cables:

1. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power.
2. Provide copper conductors with conductivity of not less than 98 percent at 20°C (68°F).
3. Conductors shall be copper THHW or XHHW inside cabinets or outside the cavern unless otherwise indicated. Specialized cords shall be used for the main power feeder and lighting branch circuits as indicated on the drawings and in 16900.

B. Connectors and Terminals:

1. Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for a high humidity cave environment.

C. Electrical Connection Accessories:

1. Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties as recommended for use by accessories manufacturers for a high humidity cave environment.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify the Owner in writing of conditions detrimental to proper completion of the work.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standards of Installation" to ensure that products fulfill requirements.
- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.
 1. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise by the Owner.
 1. Provide temporary service during interruptions to existing facilities.
 2. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems.
 3. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated on the drawings.
- E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated.
 1. Exercise care to avoid cutting through tapes which will remain on conductors.
 2. The "ringing" of copper conductors while skinning wire is not acceptable.

3. All waste from stripping or wires and cables must be strictly accounted for and removed from the cavern and disposed of properly. No wire or insulation fragments can be left within the cave.
- G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors.
1. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings.
 2. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's Standard 486A.
- I. Provide PVC conduit and fittings as indicated for high humidity atmospheres.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements.
- B. Correct malfunctioning units at site, then retest to demonstrate compliance.

End of Section

SECTION 16143

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Wires and Cables - Section 16120
- B. Electrical Boxes and Fittings - Section 16135
- C. Electrical Connections for Equipment - 16142

1.2 DESCRIPTION OF WORK

- A. The extent of wiring device work is indicated by drawings and schedules.
 - 1. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
 - Receptacles.
 - Ground-fault circuit interrupters.
 - Switches.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.
- B. NEC Compliance:
 - 1. Comply with NEC as applicable to installation and wiring of electrical wiring devices.
- C. UL Compliance:
 - 1. Comply with applicable requirements of UL 20, 486A, 498 and 943 pertaining to installation of wiring devices.
 - 2. Provide wiring devices which are UL-listed and labeled.

1.4 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data on electrical wiring devices.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. General:

1. Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA Standards Publication No. WD 1.

2.2 RECEPTACLES

A. Duplex:

1. Provide duplex, Specification grade receptacles, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20-amperes, 125-volts, with metal plaster ears; design for side wiring with NEMA configuration 5-20R unless otherwise indicated.

B. Ground-Fault Interrupters:

1. Provide "feed-through" type, ground-fault circuit interrupters, with heavy-duty duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and of being installed in a 2-3/4" deep outlet box without adapter, grounding type UL-rated Class A, Group 1, rated 20-amperes, 120 volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; equip with NEMA configuration 5-20R.

2.3 CONNECTORS

A. Connectors:

1. Provide compression like sealed connectors for connecting cords to composite boxes and enclosures.

2.4 SWITCHES

A. Snap:

1. Provide sealed switches suitable for operating relays within a relay panel suitable for operation within a high humidity cave environment.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements in a high humidity cave environment.
- B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring- devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.
- D. Install stainless steel wall plates inside the relay cabinets and service entrance cabinets.
- E. Install wiring devices after wiring work is completed.
- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices.
 - 1. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B.
 - 2. Use properly scaled torque indicating hand tool.
 - 3. All connections to a receptacle must be made by using the screw terminals. Push in connections in the back of the receptacle will not be allowed.

3.2 GROUNDING

- A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Use the approved pigtails.
- B. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.3 TESTING

- A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits.
- B. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

End of Section

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Electrical Requirement - Section 16010
- B. Codes and Standards - Section 16028
- C. Raceways - Section 16110
- D. Wires and Cables - Section 16120
- E. Panelboards - Section 16470

1.2 DESCRIPTION OF WORK

- A. Extent of electrical identification work is indicated by drawings and schedules.
- B. Types of electrical identification work specified in this section include the following:

- Buried cable warnings.
 - Electrical power, control and communication conductors.
 - Operational instructions and warnings.
 - Equipment/system identification signs.
 - Main disconnects.
 - Panels.

1.3 QUALITY ASSURANCE

- A. NEC Compliance:
 - 1. Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.
- B. UL Compliance:
 - 1. Comply with applicable requirements of UL Standard 969, "Marking and Labeling Systems," pertaining to electrical identification systems.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION MATERIALS

A. General:

1. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application.
2. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.2 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General:

1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.

2.3 CABLE/CONDUCTOR IDENTIFICATION BANDS

A. General:

1. Provide manufacturer's standard, aluminum, wrap-around, cable/conductor markers, of size required for proper application, and numbered to show circuit identification.

2.4 PLASTICIZED TAGS

A. General:

1. Manufacturer's standard preprinted, or partially preprinted, accident-prevention and operational tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate preprinted wording including large-size primary wording, e.g., "DANGER, CAUTION, DO NOT OPERATE."

2.5 SELF-ADHESIVE PLASTIC SIGNS LOCATED INSIDE CABINETS

A. General:

1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, preprinted, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
2. Colors:
 - a. Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

2.6 ENGRAVED PLASTIC-LAMINATE SIGNS TO MARK CABINETS AND EQUIPMENT

A. General:

1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness:
 - a. 1/16", except as otherwise indicated.
3. Fasteners:
 - a. Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.

B. Coordination:

1. Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

C. Regulations:

1. Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 CORD IDENTIFICATION

A. General:

1. Where electrical cords are loose laid exposed in the cavern, the cord identification that be included where it enters or leaves lighting control panels and at light fixtures.

3.3 UNDERGROUND CABLE IDENTIFICATION

A. General:

1. During backfilling/topsoiling of each exterior underground electrical, signal or communication cable, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.

- a. Install line marker for every buried cable, regardless of whether direct-buried or protected in conduit.

3.4 CABLE/CONDUCTOR IDENTIFICATION

A. General:

1. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/ cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided.
2. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

3.5 OPERATIONAL IDENTIFICATION AND WARNINGS

A. General:

1. Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures.
2. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

3.6 EQUIPMENT/SYSTEM IDENTIFICATION

A. General:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/ signal systems, unless unit is specified with its own self-explanatory identification or signal system.
2. Except as otherwise indicated, provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where two lines are required), white lettering in black field.
3. Provide text matching terminology and numbering of the contract documents and shop drawings.
4. Provide signs for each unit of the following categories of electrical work:

Panelboards, electrical cabinets and enclosures.
Equipment within the enclosures

- B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing by cavern personnel without interference of operation and maintenance of equipment or visible by the cavern visitors.

1. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate

End of Section

SECTION 16470

PANELBOARDS AND/OR LOAD CENTERS

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Electrical Requirements - Section 16010
- B. Codes and Standards - Section 16028
- C. Tests and Demonstration of Complete Electrical System - Section 16030
- D. Raceways - Section 16110
- E. Wires and Cables - Section 16120
- F. Service Entrance - Section 16420

1.2 DESCRIPTION OF WORK

- A. Extent of panelboard and load center and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.
- B. Types of panelboard and load centers and enclosures in this section include the following:
 - Service-entrance panelboard and load centers.
 - Power-distribution panelboard and load centers.
 - Lighting and appliance panelboards and load centers.
- C. Refer to other Division-16 sections for cable/wire, connectors, and electrical raceway work required in conjunction with panelboard and load centers and enclosures; not work of this section.

1.3 QUALITY ASSURANCE

- A. Installers Qualifications:
 - 1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.

B. NEC Compliance:

1. Comply with NEC as applicable to installation of panelboard and load centers, cabinets, and cutout boxes.
2. Comply with NEC requirements pertaining to installation of wiring and equipment in hazardous locations.

C. UL Compliance:

1. Comply with applicable requirements of Standard No. 67, "Electric Panelboards," and standards No.'s 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures.
2. Provide units which are UL-listed and labeled.

1.4 SUBMITTALS**A. Product Data:**

1. Submit manufacturer's data on panelboard and load centers.

PART 2 - PRODUCTS**2.1 PANELBOARDS****A. General:**

1. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation.
2. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

2.2 SERVICE-ENTRANCE PANELBOARDS

- A. Provide dead-front safety construction factory-assembled service-entrance circuit-breaker type panelboards in sizes and ratings as indicated.
- B. Equip with panelboard unit devices, of types, ratings and characteristics indicated.
- C. Construct with rectangular shaped bus bars of solid copper or aluminum, with conductivity not less than 98 percent, which are securely mounted and braced, and with solderless lugs bolted to main bus bars suitable for service with 277/480 volt, 3-phase, 4-wire, system.
- D. Provide branch circuits with molded-case type single-pole circuit-breakers, with toggle handles that indicate when tripped.
- E. Select enclosures which are fabricated by same manufacturer as panelboards, and which mate properly with panelboards.

- F. Provide panelboards with UL markings indicating "Suitable for use as service-entrance equipment."

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and arrangement shown; with anti-turn solderless pressure type main lug connectors approved for copper conductors.
- B. Select unit with feeder connecting at top of panel.
- C. Equip with copper or aluminum bus bars with not less than 98 percent conductivity, and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections.
- D. Provide molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicate when tripped.
- E. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously.
- F. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures.
- G. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for copper or aluminum conductors; equip with copper or aluminum bus bars, full-sized neutral bar, with bolt-in or plug-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped.
- B. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare uninsulated grounding bars suitable for bolting to enclosures.
- C. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.

2.5 PANELBOARD ENCLOSURES

- A. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knock-outs and wiring gutters.
- B. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated.
- C. Equip with interior circuit-directory frame, and card with clear plastic covering.
- D. Provide baked gray enamel finish over a rust inhibitor coating.
- E. Design enclosures for recessed mounting.
- F. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.

2.6 PANELBOARD ACCESSORIES

- A. Provide panelboard accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, circuit-breakers, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

2.7 LOAD CENTERS

- A. Provide dead-front safety type load centers as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for copper or aluminum conductors; equip with copper or aluminum bus bars, full-sized neutral bar, with bolt-in or plug-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped.
- B. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare uninsulated grounding bars suitable for bolting to enclosures.
- C. Select enclosures fabricated by same manufacturer as load centers, which mate properly with load centers.

2.8 LOAD CENTER ENCLOSURES

- A. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knock-outs and wiring gutters.

- B. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all load center enclosures keyed alike, with piano door hinges and door swings as indicated.
- C. Equip with interior circuit-directory frame, and card with clear plastic covering.
- D. Provide baked gray enamel finish over a rust inhibitor coating.
- E. Design enclosures for recessed mounting.
- F. Provide enclosures which are fabricated by same manufacturer as load centers, which mate properly with load centers to be enclosed.

2.9 LOAD CENTER ACCESSORIES

- A. Provide load center accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, circuit-breakers, ground-fault protection units, etc., as recommended by load center manufacturer for ratings and applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine areas and conditions under which panelboards and load centers and enclosures are to be installed, and notify the Owner in writing of conditions detrimental to proper completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PANELBOARD AND LOAD CENTERS

- A. General:
 - 1. Install panelboard and load centers and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of panelboard and load centers and enclosures with cable and raceway installation work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

1. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL standards 486A and B.
- D. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.
- E. Provide properly wired electrical connections within enclosures.
- F. Fill out panelboard and load center's circuit directory card upon completion of installation work.
- G. Insert fuses, of ratings indicated, in installed panelboard and load centers, if any.

3.3 GROUNDING

- A. Provide equipment grounding connections for panelboard and load centers as indicated.
- B. Tighten connections to comply with tightening torques specified in UL standards 486A and B to assure permanent and effective grounds.

3.4 MOUNTING HEIGHTS/CLEARANCES

- A. General:
 1. Mount panelboards, circuit breakers, and disconnecting switches so the height of the operating handle at its highest position will not exceed 78 inches from the ground.
 2. The contractor shall maintain proper NEC clearances around each panel, load center, and other electrical equipment. Generally, at this time, the clearances are 30 inches in width, by 36 inches in front, extending from the floor to 6 1/2 feet above the floor.

3.5 FIELD QUALITY CONTROL

- A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization of panelboard and load centers, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, check panelboard and load centers for electrical continuity of circuits, and for short-circuits.
- D. Subsequent to wire and cable hook-ups, energize panelboard and load centers and demonstrate functioning in accordance with requirements.

1. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

End of Section

SECTION 16510

INTERIOR CAVERN LIGHTING

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Basic Electrical Requirements - Section 16010
- B. Codes and Standards - Section 16028
- C. Wires and Cables - Section 16120
- D. Electrical Boxes and Fittings - Section 16135

1.2 DESCRIPTION OF WORK

- A. Extent of lighting fixture work is indicated by drawings and schedules.
- B. Types of lighting fixtures in this section include the following:

LED

- C. Applications of lighting fixtures required for project include the following:

Cavern Formation Lighting
Emergency/Illuminated and non-illuminated railings

1.3 SUBMITTALS

- A. See Section 01300 – Administrative Requirements for submittal procedures
- B. Product Information: Provide manufacturer's product data for each light fixture, all accessory components, and other products required for complete installation
- C. Shop Drawings:
 - 1. As required for general fabrication and/or assembly and installation for each fixture type
 - 2. At fixture types A, A1, and A2: provide shop drawings indicating overall dimensions for layout and details of all railing system components, including, but not limited to posts, railing sections, lengths of illuminated sections, railing heights, locations of drivers, transition and termination details, anchorage and installation details
- D. Sample and Mock-up: Provide one operating illuminated sample of fixture Type A2, minimum 6' long, with at least one intermediate post-to-rail connection and one termination detail, and specified finish. Contractor shall mock-up typical installation of railing with post detail as indicated. Mock-up shall illustrate lighting characteristics (pattern and level of illumination). Verify location of mock-up with Owner and Engineer. Mock-up shall illustrate use and characteristics of non-shrink grout used to set post, but post base need not be provided with protective coating. Mock-up shall remain in place for the duration of project. Upon completion of project, remove mock-up, provide sample to Owner and patch post base hole.

- E. Installation instructions: Provide manufacturer's installation instructions for each light fixture, all accessory components, and other products required for complete installation.
- F. Warranty: Provide manufacturer's standard warranty information for each product.

1.4 QUALITY ASSURANCE

A. Installer's Qualifications:

1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.

B. Store lighting fixtures in clean dry place.

1. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. On site review of submittals, sample and mockup (Fixture Type A2, only)

1. At the time of submittal, after preliminary review of submittal information (other than sample/mock-up) by Engineer, Contractor shall arrange and coordinate with the Engineer a time to review mock-up, shop drawings and other product information on site. Approved mock-up shall be used, in addition to other information, to determine acceptable standards for demolition and installation methods, as well as finishes, lighting characteristics and overall installation.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. General:

1. Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, LED lamps, lamp holders, reflectors, LED drivers and power supplies, and wiring.
2. Ship fixtures factory-assembled, with parts required for a complete installation.

B. Fixture Types: Refer to Section 16550 – Light Fixture Specifications

2.2 ACCESSORY COMPONENTS

- A. Non-shrink grout (Epoxy): Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Protective Epoxy Coating: Water-Based Tile Clad Epoxy coating and Pro-Cryl Universal Primer, as manufactured by Sherwin-Williams, or equivalent with prior approval.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF INTERIOR LIGHTING FIXTURES

- A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other electrical work as appropriate to properly interface installation of interior lighting fixtures with other work, especially the lighting control panel.
- C. Fasten fixtures railings securely to the trail and cavern floor as indicated on the drawings and drawing details.
- D. Fasten fixtures (A, C) securely to indicated weighted base as indicated in the drawings and specifications
- E. Fasten fixtures (F) securely to cavern wall or to an aluminum post as indicated on the drawings. At post installation:
 - 1. Provide protective epoxy coating to post bases (shop applied) prior to delivering to cavern site.
 - 2. Install post base in core drilled hole set in epoxy grout as indicated. Temporarily brace as required until grout sets.
- F. Tighten connectors and terminals, including screws and bolts, to comply with tightening torques specified in UL Standards 486A and B.
- G. Support surface mounted fixtures greater than 2' in length at a point in addition to the outlet box fixture stud.

3.3 ADJUSTING AND CLEANING

- A. Clean interior lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. Remove all debris from demolition and installation activities, leaving no foreign materials in the cavern.

3.4 FIELD QUALITY CONTROL

- A. Upon completion of installation of interior lighting fixtures, and after new cavern circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.
 - 1. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.5 GROUNDING

- A. Bond light fixture to the branch circuit ground system using approved ground bonding connectors and approved wire.
- B. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

End of Section

SECTION 16535

EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Electrical Requirements - Section 16010
- B. Codes and Standards - Section 16028

1.2 DESCRIPTION OF WORK

- A. Extent of emergency lighting work is indicated by drawings and schedules.
- B. Types of emergency lighting fixtures in this section include the following:

Unitized battery powered inverters.

1.3 QUALITY ASSURANCE

- A. Installers Qualifications:
 - 1. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project. This requirement does not require prior cavern electrical wiring experience but does include wiring in sensitive areas where extreme attention to details and absolute supervision of workers is required. Such work areas might include clean rooms, specialized industrial facilities, and certain areas of hospitals.
- B. Codes and Standards:
 - 1. NEC Compliance:
 - a. Comply with NEC as applicable to installation and construction of emergency lighting.
 - 2. UL Compliance:
 - a. Provide emergency lighting fixtures which are UL-listed and labeled.
 - 3. NFPA Compliance:
 - a. Comply with applicable requirements of NFPA 101, "Life Safety Code."

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's technical product data on emergency lighting fixtures.

B. Maintenance Data:

1. Submit maintenance data and parts list for each emergency lighting fixture and accessory; including "trouble-shooting" maintenance guide.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle 120 VAC inverter equipment carefully to prevent equipment damage.
- B. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 EMERGENCY 120 VAC INVERTER POWER SUPPLY

A. General:

1. Provide self-contained battery powered inverter unit for mounting in the lighting control cabinets in order to feed 120 VAC emergency lighting circuits.
2. Design unit to automatically transfer to battery supply on loss of normal AC power and to operate 120 VAC lighting circuits.
3. Furnish self contained battery powered unit with:
 - a. adequate capacity battery for code compliant 90 minute length of operation
 - b. automatic charging with automatic battery protection
 - c. brownout protection
 - d. deep discharge battery protection
 - e. automatic transfer to AC power after a time delay
 - f. automatic 5 minute discharge test once a month
 - g. automatic 30 minute discharge test once every 6 months
 - h. Unit to contain automatic self testing diagnostics to provide monthly and every 6 month testing in compliance with NFPA 101.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which emergency lighting emergency equipment is to be installed, and substrate which will support lighting fixtures.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 GROUNDING

- A. Bond emergency light inverter equipment and the emergency lighting circuit(s) to the branch circuit ground system using approved ground bonding connectors and approved wire.

- B. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.5 FIELD QUALITY CONTROL

- A. Upon completion of installation of emergency lighting circuits, apply electrical energy to demonstrate capability and compliance with requirements.
- B. Test emergency lighting to demonstrate operation under emergency conditions.
- C. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

End of Section

SECTION 16900

CATALOG SHEETS

The pages in this section are catalog sheets which show major material items required for the project. Specific manufacturers have been identified, but equivalent material items are welcome, even for specialized applications. If material items other than those indicated are to be provided, prior approval from the Engineer is required.

Prior approval shall not be required for material items which a consensus of manufacturers would agree to be of equivalent quality and performance. Material items that cannot have substitutions or equivalents will be so marked.

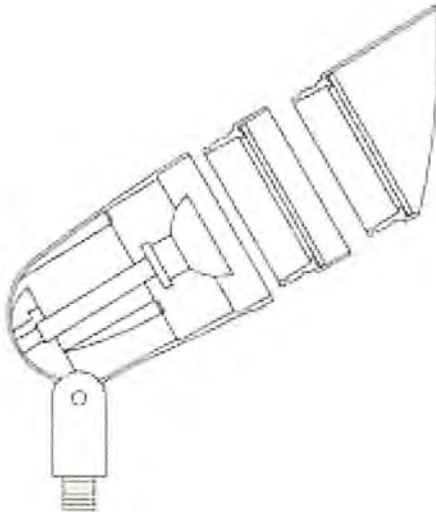
Catalog sheets have been included so that the bidder can have a better understanding of the material item requirements.

End of Section

QUANTITY: 20

Composite Bullyte (BU1) Specification Sheet

Project Name:	Location:	MFG: Philips Hadco
Fixture Type:	Catalog No.:	Qty:



Ordering Guide

Example: BU1 A

Product Code	BU1	Composite Bullyte
Finish	A H G	Black Bronze Verde

*1 US and CAN: 50 Watt PAR 20, HID/INC.

*2 US: No directional issues. CAN: Horizontal position goes over temperature. Currently undergoing testing to see what lower wattage will pass.

USE 5000°K PAR 20 WET LOCATION LAMPS

Specifications

HOUSING:

Fully rotatable shroud, gasketed, ULTEM® High Performance Polymer composite. One-piece injection molded ULTEM® High Performance Polymer composite. Fully-adjustable swivel arm with vibration-proof locking teeth. Gasketing is silicone. Fasteners are 300 series stainless steel. 1/2" NPS male threads to screw onto accessory mounting stake or junction box, sold separately.

FINISH:

Composite is textured, pressure formed, molded-in-color.

OPTICAL ASSEMBLY:

Provided with optional shrouds only.

LAMPING:

50 Watt Maximum HID. 50W maximum PAR20/R20 medium base lamp. (USA) 35W maximum PAR20/R20 medium base lamp. (CANADA) Lamp is not included. Lower wattage lamps are acceptable. (Note: If HID or R lamp is used, accessory shroud must also be used.).

ELECTRICAL ASSEMBLY:

4kv rated porcelain mini-can base. Nickel-plated screw shell with center contact.

BALLAST:

Must order inground (IBH) or above ground (ABH) ballast housing separately.

WARRANTY:

Ten-year limited warranty.

CERTIFICATIONS:

ETL listed to U.S. safety standards for wet locations. cETL listed to Canadian safety standards for wet locations. Manufactured to ISO 9001:2008 Standards.

Width:

3 7/8" (98mm)

Length:

8 1/2" (216mm)

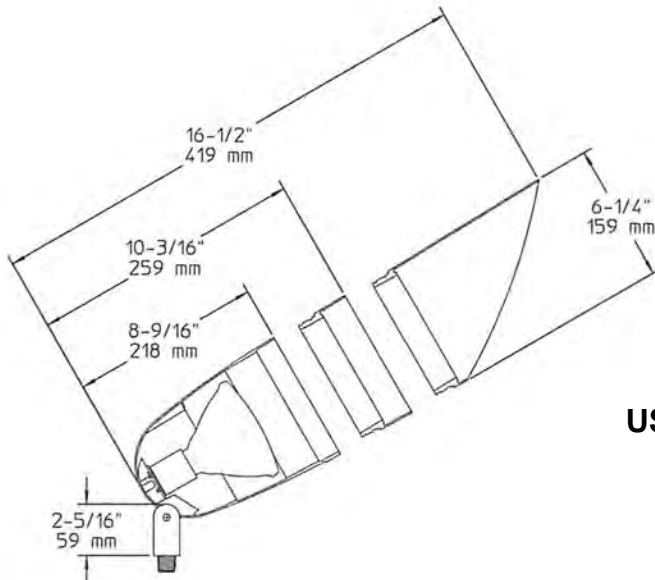
Max. Weight:

.95 lb.

QUANTITY: 5

Incandescent Composite Bullyte (BU4) Specification Sheet

Project Name:	Location:	MFG: Philips Hadco
Fixture Type:	Catalog No.:	Qty:



Ordering Guide

Example: BU4 A

Product Code	BU4	Incandescent Composite Bullyte
Finish	A G H	Black Verde Bronze

*1 US and CAN: 150 Watt PAR 38 Incandescent without lens and shroud (Cannot use HID in open fixture).
 *2 US: 100 Watt PAR 38 INC/HID with shroud / CAN: 70 Watt PAR 38 INC/HID with shroud.

USE 5000°K PAR 38 WET LOCATION LAMPS

Specifications

HOUSING:

Fully rotatable shroud, gasketed, ULTEM® High Performance Polymer composite. Shroud is optional. One-piece injection molded ULTEM® High Performance Polymer composite. Fully-adjustable swivel arm with vibration-proof locking teeth. Gasketing is silicone. Fasteners are 300 series stainless steel. 1/2" NPS male threads to screw onto accessory mounting stake or junction box, sold separately.

FINISH:

Composite is textured, pressure formed, molded-in-color.

OPTICAL ASSEMBLY:

One-piece injection molded ULTEM High Performance Polymer with silicone O-ring gasket. Lens is siliconed into shroud. BU4, Shroud Optional. BUN4, BUW4, Shroud included.

LAMPING:

100W maximum PAR30/R30 or PAR38/R40 medium base lamp. 100W maximum MH medium base: E17 100W maximum MH medium base: PAR38 Lamp is not included. Lower wattage lamps are acceptable. HID PAR30 MH or MV acceptable with remote ballast (not included).

ELECTRICAL ASSEMBLY:

4kv rated porcelain mini-can base. Nickel-plated screw shell with center contact.

BALLAST:

Must order inground (IBH) or above ground (ABH) ballast housing separately.

WARRANTY:

Ten-year limited warranty.

CERTIFICATIONS:

ETL listed to U.S. safety standards for wet locations. cETL listed to Canadian safety standards for wet locations. Manufactured to ISO 9001:2008 Standards.

Width:

6 1/4" (159mm)

Length:

16 1/2" (419mm)

Max. Weight:

3.75 lb

FIXTURE 'C'

FIXTURE 'C' QUANTITY: 40



Date: _____
Type: _____
Firm Name: _____
Project: _____



iW Burst Compact Powercore

8° (No Spread Lens), Gray Housing, UL/cUL/CE, Architectural

Compact architectural and landscape LED spotlight with intelligent white light

iW Burst Compact Powercore is a high-output, exterior-rated LED spotlight designed for accent and site lighting. iW Burst Compact Powercore combines channels of warm and cool LEDs to offer variable color temperatures ranging from 2700 K to 6500 K. Architectural and landscape versions support a range of uplighting, floodlighting, and decorative lighting applications.

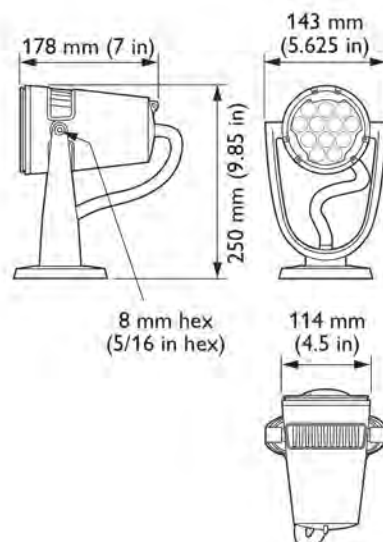
iW Burst Compact Powercore

Compact architectural and landscape LED spotlight with intelligent white light

- Integrates patented Powercore technology—Powercore rapidly, efficiently, and accurately controls power output to luminaires directly from line voltage, eliminating the need for an external power supply. Contractor-friendly installation dramatically simplifies installation and lowers total system cost.
- Support for a wide range of architectural and landscape applications— Architectural luminaires feature an integrated yoke with canopy base for mounting to standard US junction boxes or directly to a flat surface or substrate as local codes permit. Landscape luminaires feature a 0.5 in NPT threaded post for mounting to standard junction boxes and third-party mounting accessories such as stanchion mounts, posts, and stakes for use in softscape and hardscape applications.
- Wide range of color temperature and brightness— Channels of warm white and cool white LEDs produce color temperatures ranging from 2700 K to 6500 K.
- Exchangeable optics and accessories—Available 14°, 23°, 41°, and asymmetric 10° x 41° spread lenses project a soft-edge beam to support a wide range of lighting applications. Native 8° beam angle offers extended light projection. Available glare shields block spill light, while honeycomb louvers limit the spread of light for a more focused and intense beam.
- Versatile light positioning—Luminaires can tilt through a full 180°. Architectural luminaires also rotate through a full 360° for precise aiming.
- Universal power input range—Accepts a universal power input range of 100 to 240 VAC, allowing long luminaire runs and consistent installation in any location around the world.
- Outdoor rated—With a rugged, die-cast aluminium housing fully sealed for maximum luminaire life and IP66-rated for outdoor applications, iW Burst Powercore is ideal for use in damp or wet locations.

For detailed product information, please refer to the iW Burst Compact Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwburstcompactpc/

Dimensions



Specifications

Due to continuous improvements and innovations, specifications may change without notice.



iW Burst Compact Powercore
8° (No Spread Lens), Gray Housing, UL/cUL/CE, Architectural

Output

Color Temperature*	2700 K to 6500 K
Beam Angle	8°
Lumens†	709
Efficacy (lm/W)	32.5
LED Channels	2700 K/4000 K/6500 K

SET FIXTURE TO 5000°K

Electrical

Input Voltage	100 to 240 VAC, auto-ranging, 50/60 Hz
Power Consumption	17.5 W
<small>(Maximum at full output, steady state)</small>	

Control

Interface	Data Enabler Pro (DMX/Ethernet)
-----------	---------------------------------

Control System

Philips Color Kinetics full range of controllers, including Light System Manager, Video System Manager Pro, iPlayer 3, Antumbra iColor Keypad, and ColorDial Pro, or third-party controllers

ActiveSite	ActiveSite Ready
------------	------------------

Lumen Maintenance

Threshold§	Ambient Temperature	Reported¶	Calculated¶
L ₇₀	25 °C	50,000	
	50 °C	35,000	
L ₅₀	25 °C	50,000	
	50 °C	50,000	

Physical

Dimensions <small>(Height x Width x Depth)</small>	250 x 114 x 178 mm (9.85 x 4.5 x 7 in)
Weight	3.9 kg (8.7 lb)
Housing Material	Die-cast aluminium, powder-coated finish
Lens	Tempered glass
Luminaire Connections	1.8 m (6 ft) unified power/data cable with flying leads

Temperature Ranges

-40 to 50 °C (-40 to 122 °F) Operating
-20 to 50 °C (-4 to 122 °F) Startup
-40 to 80 °C (-40 to 176 °F) Storage

Vibration Resistance	Complies with ANSI C136.31, 3G
Mechanical Impact	IK07
Humidity	0 to 95%, non-condensing

Luminaire Run Lengths

To calculate luminaire run lengths and total power consumption for your specific installation, download the Configuration Calculator from www.colorkinetics.com/support/install_tool/

Certification and Safety

Approbation	UL/cUL, FCC Class A, CE, PSE, C-Tick, CQC, SAA
Environment	Dry/Damp/Wet Location, IP66



CAVE SPECIALIST WILL INDICATE TO THE CONTRACTOR IN THE FIELD DURING CONSTRUCTION WHICH SPREAD LENS, IF ANY, WILL BE ADDED TO FIXTURE 'B' TO CHANGE BEAM SPREAD FROM THE STANDARD 8°.

SEE CATALOG SHEET FOR SPREAD LENS QUANTITIES.

* Correlated color temperature (CCT) complies with ANSI C78.377-2008 for the chromaticity of solid state lighting products.

† Lumen output measurements comply with IES LM-79-08 testing procedures.

§ L_{xx} = xx% lumen maintenance (when light output drops below xx% of initial output). All values are given at B10, or the median value where 90% of the LED population is better than the reported or calculated lumen maintenance measurement.

¶ Lumen maintenance figures are based on lifetime prediction graphs supplied by LED source manufacturers. Whenever possible, figures use measurements that comply with IES LM-80-08 testing procedures. In accordance with TM-21-11, Reported values represent the interpolated value based on six times the LM-80-08 total test duration (in hours). Calculated values represent time durations that exceed six times the total test duration.



DATE	
PROJECT	
TYPE	
NOTE	
PREPARED BY	

VL-WP34Q

Up / Down LED Wall Sconce



The LEPG WP34Q architectural wall luminaire provides up AND down lighting with a wide distribution designed to replace HID lighting systems up to 70w MH or HPS. Typical wall mounted lighting applications include retail centers, industrial parks, schools and universities, public transit and airports, office buildings and medical facilities. Mounting heights of 8 to 16 feet can be used based on light level and uniformity requirements. Comes with a 5 year/50,000 hour limited warranty.

FEATURES

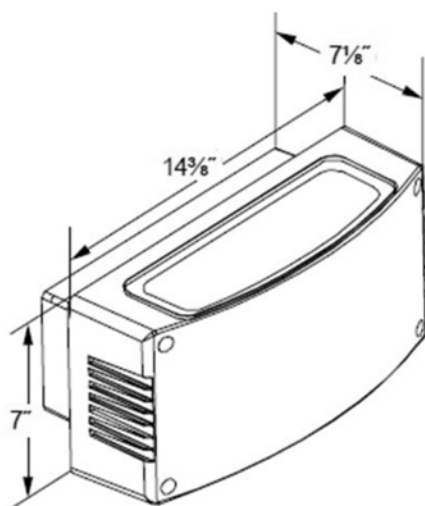
- Energy Savings: Over 66% compared to HID light sources
- Improved lumen maintenance
- Utilizes high efficient Lumileds LED's
- Operating temperatures: -30°C ~ 60°C
- Driver: Class 2, Constant current, 120-277v, 50/60Hz
- UL listed for wet locations
- Dimming, occupancy sensors, photo cell capable (optional)
- Operating Life: >50,000 hours

CONSTRUCTION

- Housing is heavy-duty die-cast aluminum
- 1/2" Coin plugs with O-rings for conduit, sensors or photo cell
- Powder coat bronze finish (standard) various colors available (custom).
- Clear glass lens
- Silicone gasket to prevent leakage and provide weather-tight protection.
- Mounting: Cast-in Template for Mounting Directly Over a 4" Recessed Outlet Box, or use 1/2" Surface Conduit or quick-mount bracket.

OPTIONS

- (PC) Button photo cell



Model Number	INPUT POWER	DELIVERED LUMENS	EFFICACY	COLOR TEMP (CCT)	CRI	RATED LIFE	EQUIVILANT WATTAGE	B	U	G
VL-WP34Q	32W	3,387	97 LMS./W	4000K	70	>90,000HRS	70W MH	1	5	1



Crystal Lighting Corporation - 13182 Flores St., Santa Fe Springs, Ca. 90670

Phone: 562-944-0223 - Fax: 562-944-0225 - WEB: www.crystallighting.us

Crystal Lighting is BUY AMERICAN compliant - All products are proudly manufactured and/or assembled in the USA

TYPICAL RAILING LIGHTING REQUIREMENTS

How to specify your energy efficient handrail

liniLED® LED Illuminated Handrail

As each lighting project is unique, all the components of the liniLED® LED Illuminated Handrail are professionally customized. Therefore, it is of great importance to provide fully dimensioned plans, DWG files and detailed drawings, in addition to the useful menu below.

liniLED® Illuminated Handrail Technical Information

Models	DECO low output	POWER medium output	PSP high output
LEDs / ft	11	11	37
Lumen Output / ft	33-39 lumen/ft (112 lm/m)	113-122 lumen/ft (368 lm/m)	227-257 lumen/ft (741 lm/m)
Watts / ft	1 W/ft (3.3 W/m)	1.28 W/ft (4.6 W/m)	2.89 W/ft (9.7 W/m)
CRI	85-90	85-90	85-90
Max. single run	66 ft (20 m)	33 ft (10 m)	33 ft (10 m)
Environment	<input type="checkbox"/> Indoor <input type="checkbox"/> Outdoor	<input type="checkbox"/> Indoor <input type="checkbox"/> Outdoor	<input type="checkbox"/> Indoor <input type="checkbox"/> Outdoor
Mounting	<input type="checkbox"/> Wall <input type="checkbox"/> Post	<input type="checkbox"/> Wall <input type="checkbox"/> Post	<input type="checkbox"/> Wall <input type="checkbox"/> Post
Infill (Post mounting)	<input type="checkbox"/> Glass <input type="checkbox"/> Railing <input type="checkbox"/> Cables <input type="checkbox"/> Custom	<input type="checkbox"/> Glass <input type="checkbox"/> Railing <input type="checkbox"/> Cables <input type="checkbox"/> Custom	<input type="checkbox"/> Glass <input type="checkbox"/> Railing <input type="checkbox"/> Cables <input type="checkbox"/> Custom
Size/Diameter	<input type="checkbox"/> 1.66" (42.4 mm) <input type="checkbox"/> 1.90" (48.3 mm)	<input type="checkbox"/> 1.66" (42.4 mm) <input type="checkbox"/> 1.90" (48.3 mm)	<input type="checkbox"/> 1.66" (42.4 mm) <input type="checkbox"/> 1.90" (48.3 mm)
Material	<input type="checkbox"/> AISI 316 Stainless Steel <input type="checkbox"/> AISI 304 Stainless Steel	<input type="checkbox"/> AISI 316 Stainless Steel <input type="checkbox"/> AISI 304 Stainless Steel	<input type="checkbox"/> AISI 316 Stainless Steel <input type="checkbox"/> AISI 304 Stainless Steel
Colors	<input type="checkbox"/> Warm White 3000K <input type="checkbox"/> Warm White 4000K <input type="checkbox"/> RGB <input type="checkbox"/> Custom colors available	<input type="checkbox"/> Warm White 2700K <input type="checkbox"/> Warm White 3000K <input type="checkbox"/> Natural White 4000K <input type="checkbox"/> Custom colors available	<input type="checkbox"/> Warm White 2700K <input type="checkbox"/> Warm White 3000K <input type="checkbox"/> Natural White 4000K <input type="checkbox"/> Custom colors available
Bends	<input type="checkbox"/> 45° x _____ (qty) <input type="checkbox"/> 90° x _____ (qty) <input type="checkbox"/> 120° x _____ (qty) <input type="checkbox"/> Custom	<input type="checkbox"/> 45° x _____ (qty) <input type="checkbox"/> 90° x _____ (qty) <input type="checkbox"/> 120° x _____ (qty) <input type="checkbox"/> Custom	<input type="checkbox"/> 45° x _____ (qty) <input type="checkbox"/> 90° x _____ (qty) <input type="checkbox"/> 120° x _____ (qty) <input type="checkbox"/> Custom
Total length	<input type="checkbox"/> _____ ft.	<input type="checkbox"/> _____ ft.	<input type="checkbox"/> _____ ft.



liniLED® Illuminated Handrail Typical Fc. levels

	Handrail Height	0	1'	2'	3'	4'
Deco 3000K	34.5"H	4.67	3.42	1.75	0.913	0.363
	40.5"H	3.5	2.76	1.64	0.919	0.494
Deco 4000K	34.5"H	5.44	3.97	2.17	1.07	0.488
	40.5"H	4.26	3.32	2.02	1.12	0.589
Deco RGB	34.5"H	5.53	3.94	2.08	1.03	0.5
	40.5"H	4.35	3.38	2.01	1.13	0.575
Power 2700K	34.5"H	16.7	12.5	6.08	2.77	1.01
	40.5"H	12.5	10.1	5.74	3.06	1.39
Power 3000K	34.5"H	17.1	12.3	7.09	2.12	0.629
	40.5"H	13.1	10.3	6.4	3.45	0.934
Power 4000K	34.5"H	18.1	13.6	7.19	3.39	1.14
	40.5"H	13.9	11.2	6.82	3.87	1.6

NOTE:

0-10 Volt Dimming Driver required.

Diffuse lens required

Verify proposed LED lighting system (including diffuse lens cover, wiring, etc) is totally compatible with the selected railings.

	Handrail Height	0	1'	2'	3'	4'
PSP 2700K	34.5"H	30	21	11.2	5.67	1.86
	40.5"H	21.8	16.6	10	5.88	2.74
PSP 3000K	34.5"H	26.6	20	10.4	5.23	1.53
	40.5"H	21.1	17	9.8	5.88	2.62
PSP 4000K	34.5"H	30.9	22.5	13.2	5.29	1.12
	40.5"H	22.6	17.8	11.2	6.6	1.95

Specifications are correct at the time of publishing, but may be modified or improved in accordance with current electrical, safety or manufacturing methods without notification.





Lightalarms

EMERGENCY LIGHTING UPS

LIGHT SUPPORT POWER SYSTEMS COMPACT SERIES

FEATURES

- 98% efficient at full load
- PWM/MOSFET technology
- Self-testing/Self-diagnostic
- User programmable with password protection
- Standard input circuit breaker
- Standard output circuit breaker
- Micro-processor controlled
- Floor or wall mountable
- Field upgradeable (500VA steps)
- 90 min. standard run time
- Electronic and magnetic ballast compatible
- Automatic event, test and alarm log
- LCD display
- Very small footprint (stackable cabinets)
- Maintenance free standard batteries
- Forced air cooling during emergency mode only

UL listed to UL924. Meets NFPA101, NFPA70, NFPA 110, OSHA, UBC, SBCCI. N.Y City approved.

ELECTRICAL/MECHANICAL CHARACTERISTICS⁴

POWER RATING ¹ VA=W	EFFIC. AT FULL LOAD %	MAX. INPUT CURRENT (A)		HEAT LOSS IN NORMAL MODE (BTU/HR)	BATT. VDC	BATT. A	NO. OF BATT.	UPS CABINET DIMENSIONS			BATTERY CABINET DIMENSIONS ^{2,3}			NO. OF BATT. CAB.	BATT. CAB. WEIGHT LBS (EMPTY)	UPS CAB. WEIGHT LBS	BATT. WEIGHT LBS	TOTAL SYSTEM WEIGHT LBS
		120V	277V					W"	H"	D"	W"	H"	D"					
500	98	5.2	2.3	34	48	13.5	4	26	10	10	26	10	10	1	22	77	107	206
1000	98	10.5	4.5	68	48	26.5	8	26	10	10	26	10	10	2	22	77	214	335
1500	98	15.6	6.8	102	48	40	12	26	10	10	26	10	10	3	22	77	321	464
2000	98	20.8	9	136	48	52	16	26	10	10	26	10	10	4	22	77	428	592

1- System capacity can be upgraded in the field up to 2000VA by adding more battery cabinets. Re-programming required by factory service technician.

2- Batteries are installed in separate modular cabinets

3- Battery cabinets are stackable. Must be installed under the electronics cabinet

4- Special voltages can change the size, weight or number of cabinets

ORDERING INFORMATION

SYSTEM TYPE	BATTERY TYPE	INPUT VOLTAGE ³	VAW RATING	OUTPUT VOLTAGE ³	RUN TIME ²	INPUT BREAKER	OUTPUT BREAKERS ⁴	OPTIONS ¹
FTCM	-SC= Sealed Lead-Calcium	120= 120VAC 277= 277VAC	C- 500 E- 1000 G- 1500 J- 2000	120 277	90	ICB	OCBxxxx- No trip alarm OCAxxxx- With trip alarm	FB- Floor mount bracket NOFF- Normally OFF output WB- Wall mount bracket DCS- Dry summary alarm contacts INVON- Inverter on dry contact VTD- None variable BPR- Bypass relay RMP- Remote metering panel RSAP- Remote summary alarm panel RS232- Communication interface MOD- Modem SELECT MOUNTING OPTIONS
		³ Special voltages may change the size, weight or number of cabinets		³ Special voltages may change the size, weight or number of cabinets	² Other run times available		⁴ Max. 3 more additional output breakers for a total of 4. See page 145 for output breakers details.	¹ See page 145 for options description

EXAMPLE: FTCM-SC120G120-90-ICB-OCB0320-WB

**INSTALL INVERTER AND BATTERIES IN A NEMA 4X ENCLOSURE.
(SEE INSTALLED CABINET #1)**

SEE DRAWING SHEET G3.0 FOR UPS SIZES AND LOCATIONS.

EMERGENCY LIGHTING UPS



TYPE _____

CATALOG # _____

NOTES _____

Fast transfer emergency lighting, 1PH,
inverter system 500VA – 2000VA



SPECIFICATIONS

GENERAL

Design

- Stand-by no break. PWM inverter type utilizing MOSFET technology with 2ms transfer time.

Control

- Microprocessor controlled, 2 x 20-character display with touch pad controls & functions
- 5 LED indicators & alarm with ring-back feature

Metering

- Input & Output Voltage, Battery Voltage, Battery & Output Current, Output VA, Temperature, Inverter Wattage

Communications Optional RS-232 port (DB9)

ELECTRICAL INPUT

Voltage

- 120 or 277VAC 1-phase 2-wire +10% - 15%. Contact factory for all other voltages.

Input Power Walk-In

- Limiting inrush current to less than 125%, 10 times for 1 line cycle

Input Frequency 60Hz, +/-3Hz

Protection Standard Input Circuit Breaker

Harmonic Distortion <10%

Power Factor 0.5 lag/lead

ELECTRICAL OUTPUT

Voltage

- 120 or 277VAC 1-phase 2-wire. Contact factory for all other voltages.

Static Voltage

- Load current change +/-2%, battery discharge +/-12.5%

Dynamic Voltage

- +/-2% for +/-25% load step change, +/-3% for a 50% load step change, recovery within 3 cycles

Harmonic Distortion <3% THD for linear load

Output Frequency 60Hz +/- 0.05Hz during emergency mode

Load Power Factor 0.5 lag to 0.5 lead

Inverter Overload 115% for 5 minutes

Protection Standard Output Circuit Breaker (normally on)

Crest Factor 2.8

ENVIRONMENTAL CONDITIONS

Storage/Transport

- -4°F to 158°F (-20°C to 70°C) without batteries
- -0°F to 104°F (-18°C to 40°C) with batteries (max. 3 months at 104° F (40° C))

Operating temperature

- System operates safely from 32°F to 104°F (0°C to 40°C) but optimum operation is between 68° F and 86°F (20°C to 30°C). Battery performance can be affected by temperature.

Altitude

- <10,000 feet (above sea level) without de-rating

Relative Humidity

- 0 to 95% non-condensing

Audible noise 45 dBA @ 1m from surface in emergency mode

CABINETS

Modular design, freestanding or wall mount NEMA type 1 steel cabinets powder coated for corrosion and scratch resistance. Front access design. Cabinets are stackable. Top and left side conduit entry with knockouts.

INVERTER

Using MOSFET/PWM technology the inverter converts the DC voltage supplied by the batteries to AC voltage of a precise stabilized amplitude and frequency, suitable for most sophisticated electrical equipment. True sinusoidal output waveform with very low distortion (less than 3% for linear loads). Overload capability of up to 150% for 12 line cycles.

CHARGER

Fully automatic, temperature compensated, microprocessor controlled charger recharges fully discharged batteries in maximum 24 hours at nominal AC input voltage. AC input current limiting and over-voltage protection included.

BATTERY

System is provided with 10 year, maintenance free, sealed valve regulated Lead-Calcium batteries. 90 min. standard discharge time at full load under normal operating temperature. Low Voltage Disconnect protection included. No special ventilation required.

SUPERVISION

Automatic self-test consists of a 5-minute monthly and 90-minute annual function.

The front-mounted control panel includes 5 LED indicators, a 2-line 20-character LCD display, a keypad to control and monitor the internal operation of the system. This allows the operator to easily "watch" system functions as they occur and check on virtually any aspect of the system's operation. Self-diagnostic function monitors, controls, generates alarms and memorizes events.

ALARMS

High/Low Battery Charger Voltage, High/Low AC Input Voltage, Near Low Battery, Low Battery, Load Reduction Fault, Output Overload, High Ambient Temperature, Inverter Fault, Output Fault, Optional Output Circuit Breaker Trip

OPTIONAL FEATURES

Normally OFF output, Output Circuit Breakers, Output Trip Alarm, RS232 communication port, 12 Hours Fast Recharge, Remote Meter Panel, Remote Summary Alarm Panel, Summary Alarm Dry Form C Contact, Inverter on Dry Contacts, Variable Time Delay, Modem, Bypass Relays, Wall mount bracket

FACTORY START-UP

Includes one additional year of warranty. See warranty conditions.

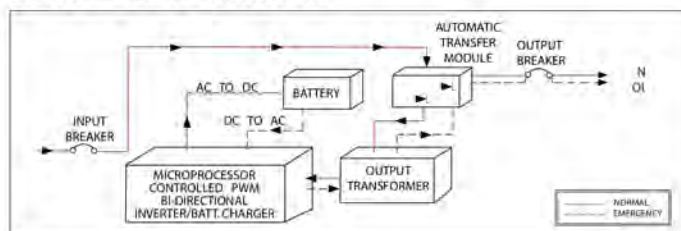
WARRANTY

 (full limited warranty conditions available upon request)

Limited manufacturer warranty is one-year, parts and labor, for system electronics or two-year with factory start-up program. Battery warranty is one year full plus 9 years pro-rata for a total of 10 years, under normal operating conditions.

System must be put in service within 180 days from ship date in order to validate warranty.

SINGLE LINE DIAGRAM



Characteristics, specifications or dimensions subject to change without notice.

FIXTURE 'A' AND 'C' SPREAD LENS

Luminaire and Accessories

Use Item Number when ordering in North America.

Luminaire

iW Burst Compact Powercore Gray Housing, UL/cUL/CE, Architectural

Item Number

523-000067-01

Philips 12NC

910503702058

Accessories

QTY

14° Spread lens	15	120-000080-04	910503701415
23° Spread lens	20	120-000080-05	910503701416
41° Spread lens	20	120-000080-06	910503701417
10° x 41° Spread lens	4	120-000080-07	910503701418
Trim Ring, Gray	65	120-000103-03	910503701420
45° Glare Shield, Gray		120-000103-04	910503701421
Full Height Glare Shield, Gray		120-000103-05	910503701422
Honeycomb Louver, Black		120-000104-01	910503701419
Power Supplies			
Data Enabler Pro, 3/4 in / 1/2 in NPT (U.S. trade size conduit)		106-000004-00	910503701210
Data Enabler Pro, PG21/PG13 (metric size conduit)		106-000004-01	910503701211

Copyright © 2018 Philips Lighting Holding B.V. All rights reserved. Chromacore, Chromasic, CK, the CK logo, Color Kinetics, the Color Kinetics logo, ColorBlast, ColorBlaze, ColorBurst, eW Fuse, ColorGraze, ColorPlay, ColorReach, iW Reach, eW Reach, DiMand, EssentialWhite, eW, EvenBalance, iColor, iColor Cove, IntelliWhite, iW, iPlayer, Optibin, and Powercore are either registered trademarks or trademarks of Philips Lighting Holding B.V. in the United States and/or other countries. All other brand or product names are trademarks or registered trademarks of their respective owners. Due to continuous improvements and innovations, specifications may change without notice.

DAS-000083-57 R02 30 Jan 2018



Philips Color Kinetics
www.philips.com/colorkinetics

Contour Series High CRI PAR20 5000K, 525lm LED Lamp with 25-Degree Beam Angle

- 90 CRI - Renders illuminated colors with great accuracy
- LED replacement for 50W halogen lamps
- 5000K - daylight
- 25-degree beam angle
- Compatible with most commercial dimmers*
- Energy efficient, long-lasting LED - over 80% reduction in energy costs compared to halogen lamps
- 25,000 hour design lifetime
- 5-year limited warranty

* Dimming range may vary based on dimmer used.

FIXTURE 'B' LAMPS

QUANTITY: 30



Specifications

Lamp Type	High CRI PAR20 5000K, 525lm, 25-degree beam angle
Model	P20-L525-C50-B25-90-W
Part Number	99012
Color Temperature	5000K
Lumen Output	525lm
Wattage	7W
Replacement Equivalent	50W Halogen equivalent
CRI	90
Efficacy	75lm/W
Beam Angle	25°
CBCP	1179 cd
Dimmable	Yes
Wet Rated?	Yes
Voltage	120V
Operating Temperature	-20°C to +40°C
Base	E26
Weight	3.9 oz.
Dimensions	2.47 x 3.25 x 2.47 in
Design life	25000 Hours
Warranty	5-Year Limited Warranty

Certifications:



FIXTURE 'B' LAMPS

QUANTITY: 10

Contour Series High CRI PAR38 5000K, 1250lm LED Lamp with 25-Degree Beam Angle

- 90 CRI - Renders illuminated colors with great accuracy
- LED replacement for 120W halogen lamps
- 5000K - daylight
- 25-degree beam angle
- Compatible with most commercial dimmers*
- Energy efficient, long-lasting LED - over 80% reduction in energy costs compared to halogen lamps
- 25,000 hour design lifetime
- 5-year limited warranty

* Dimming range may vary based on dimmer used.



Specifications

Lamp Type	High CRI PAR38 5000K, 1250lm, 25-degree beam angle
Model	P38-L1250-C50-B25-90-W
Part Number	99014
Color Temperature	5000K
Lumen Output	1250lm
Wattage	17W
Replacement Equivalent	120W Halogen equivalent
CRI	90
Efficacy	74lm/W
Beam Angle	25°
CBCP	5382 cd
Dimmable	Yes
Wet Rated?	Yes
Voltage	120V
Base	E26
Weight	15.2 oz.
Dimensions	4.72 x 5.08 x 4.72 in
Design life	25000 Hours
Warranty	5-Year Limited Warranty

Certifications:



FIXTURE 'C' BASE

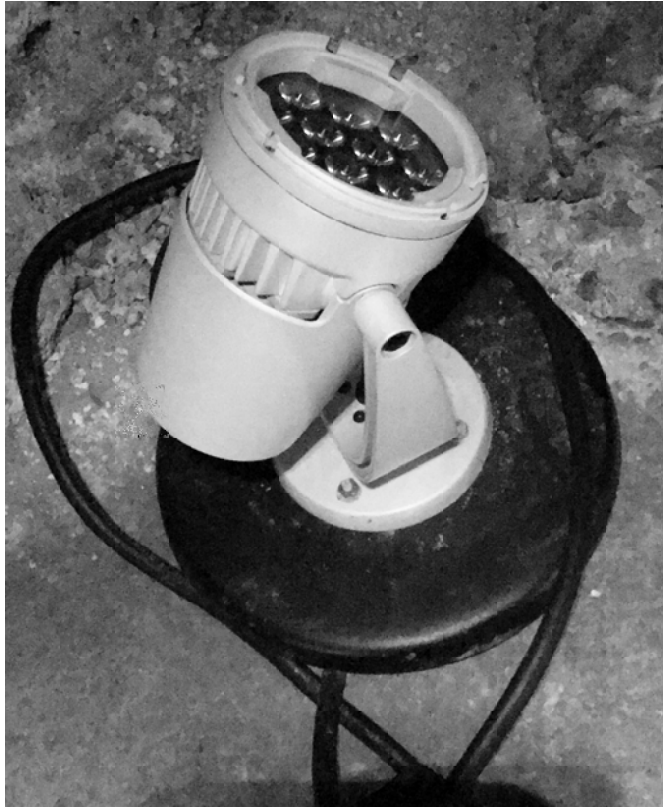


PHOTO OF EXISTING BASE ON FIXTURE 'A'

BASES



B-3-CB



B-50

Bases are generally used in conjunction with standard iron pipe to create a variety of stands or supports. The B-10 base is generally used without pipe, that is, a fixture is directly mounted to the base. Bases may also be used as weights or counterweights. All items are finished in baked black enamel.

Catalog No.	Description
B-50	50 lbs. 22 3/8" Dia. Cast Iron, Threaded for 1 1/2" Pipe
B-50-CB	B-50 Base w/Heavy Duty Casters
B-18	25 lbs. 18" Dia. Cast Iron, Threaded for 1" Pipe
B-3-CB	3 Legged w/Casters, Threaded for 1 1/4" Pipe
B-10	8 lbs. 10" Dia. Cast Iron, w/1/2" -13 Attachment Bolt

ALTMAN
Lighting, Inc.
BRINGING IMAGINATION TO LIGHT

57 Alexander Street, Yonkers, NY 10701 Tel: 914.476.7987 or 212.569.7777 Fax: 914.963.7304
visit our website at <http://www.altmanltg.com>
© 2002 Altman Stage Lighting Company, Inc.
Altman Lighting, Inc. is a subsidiary of Altman Stage Lighting Company, Inc.

72302

DISTRIBUTOR IS IN KALISPELL:
Phantom Dynamics (406-270-3326)

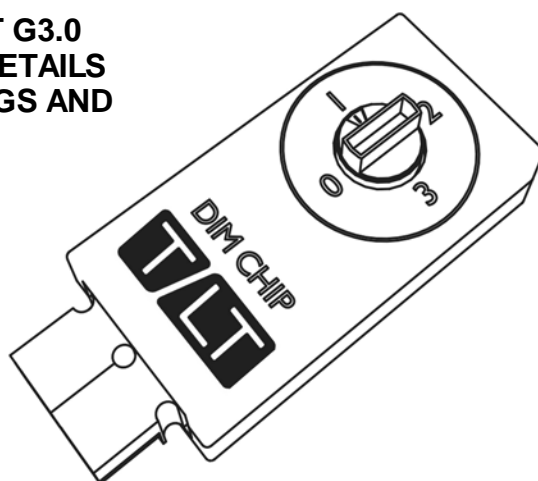
RAILING AND FIXTURE 'F' DIMMER

DIM CHIP

FEATURES

- Dim Chips are designed to be used with TILT drivers
- Limits driver wattage through control circuit
- Four level options available per chip
- Custom settings available with driver wattage levels set to customer request
- Limits both light output and corresponding wattage with no efficiency loss
- 5 year warranty

**SEE DRAWING SHEET G3.0
FOR INSTALLATION DETAILS
FOR DIMMING RAILINGS AND
FIXTURE 'F'.**



Project Name	
Date	
Type	



TILT Part Number	
------------------	--

Dim Chip Models:

DC01
DC02
DC03
CUSTOM +

SPECIFICATIONS

ALL DIM CHIP MODELS	PERCENT OF DRIVER WATTAGE			
	DC01	DC02	DC03	CUSTOM+
Dim Chip Setting 0	100%	100%	100%	Contact Lauren at 855.440.8458 for a custom Dim Chip, to set wattage or lumen levels for your application
Dim Chip Setting 1	85%	75%	50%	
Dim Chip Setting 2	75%	50%	30%	
Dim Chip Setting 3	50%	25%	10%	

FOR USE WITH

DOWNLIGHTS	PANELS
LCLCV6 LCLCV8	LGM14, LFM14 LGM22, LFM22 LGM24

DIMMER COMPATIBILITY CHART*

DRIVER	DIMMING
NOTE: Driver selection may be specific to your installation configuration. For complete listing of driver and its particular dimming compatibility, see individual TILT driver sheet.	

NOTES

*TILT drivers use a 1-10V control but are compatible with most 0-10V control systems. For details specific to your system, contact us at 855.440.8458

+ For custom Dim Chip settings, call Customer Service at 855.550.8458

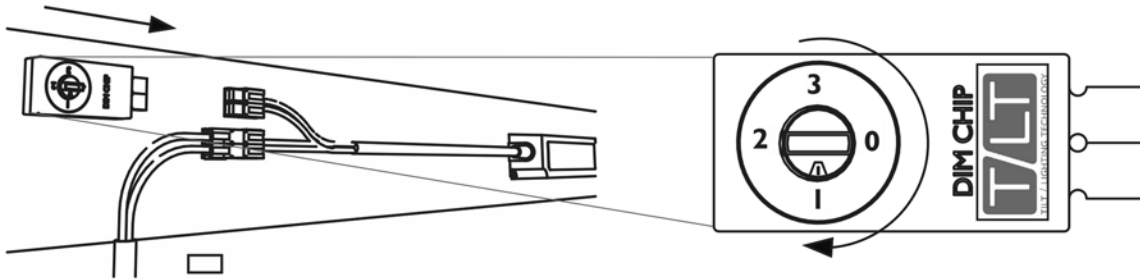
Use connector cable (Part Number **DW-10V**) which has a modular connector on one end and a plug on the other end which easily plugs into the dim chip.

RAILING AND FIXTURE 'F' DIMMER

DIM CHIP DC01, DC02, DC03

WIRING DETAIL & SETTING CONTROL

SEE INSTALLATION MANUAL FOR APPROVED INSTALLATION METHODS AND OTHER DETAILS FOR ALL DRIVERS



SETTING DIAGRAM

DC01		DC02		DC03		CUSTOM ⁺	
Setting	% of driver Wattage	Setting	% of driver Wattage	Setting	% of Driver Wattage	Setting	% of Driver Wattage
0	100	0	100	0	100	Contact Lauren at 855.440.8458 for a custom Dim Chip, to set wattage or lumen levels for your application.	
1	85	1	75	1	50		
2	75	2	50	2	30		
3	50	3	25	3	10		

SEE DRAWING SHEET G3.0 FOR ORDERING DETAILS

NOTES

- For details specific to your system, call us at 855.550.8458
- + For custom Dim Chip settings, call Customer Service at 855.550.8458
- * TILT drivers use a 1-10V control but are compatible with most 0-10V control systems. For details specific to your system, contact us at 855.440.8458